NAVFAC Naval Facilities Engineering Command
ENGINEERING AND EXPEDITIONARY WARFARE CENTER

TechData Sheet

TDS-NAVFAC-EXWC-PW-1604 Aug 2016

Sand Filter Technology

This report summarizes the findings from a demonstration of sand filter technology to determine whether the technology will save energy with a simple payback within the projected life of the equipment. The Chemworks model CW-120-H was selected for this evaluation. NAVFAC Engineering and Expeditionary Warfare Center (EXWC) performed the evaluation at the Naval Air Station Lemoore, CA. The two year evaluation period began with one year of sand filter operation. During the second year, the sand filter was removed from service to develop the baseline data.
NAVFAC EXWC determined that under the conditions of this demonstration, the sand filter technology produced exceptional energy savings. While other environmental and operational conditions may provide higher energy savings, in this project, the technology payback period was two (2) years or less, assuming a chiller cleaning schedule of two (2) years or greater, which is well within the projected twenty (20) year life of the equipment.

What is the Technology?
Sand filters provide cleaner cooling tower water by removing suspended particles in the water including very fine contaminant particles down to 0.25 microns. The sand filter used in this demonstration is designed to remove particles down to 0.5 micron particles. This high efficiency filtration saves energy and reduces operating costs with cleaner chiller condenser heat transfer surfaces, lower microbiological growth, improved corrosion rates, and reduced chiller tube cleaning frequency.

Sand Filter at NAS Lemoore

How Does It Save Energy?
A chiller's efficiency declines rapidly when condenser tubes become fouled. This technology is designed to reduce contaminants, such as minerals, scale, mud, algae, and other impurities that increase thermal resistance and reduce overall performance. These contaminants accumulate on the water side of heat transfer surfaces in both open- and closed-loop systems and without some type of water treatment system fouling will occur gradually over time, depending on the quality and temperature of the water used. Fouled heat transfer surfaces reduce the efficiency of the chiller resulting in higher energy use.

Where Should the Navy Apply It?
Based on a single demonstration, EXWC cannot make a determination as to the variety of environmental and operational conditions that would lead to optimum energy savings with a simple payback within the twenty (20) year projected life of the equipment. EXWC offers the following guidelines for determining if sand filter technology has the potential for saving energy in a local facility:

1. Does your chiller system have an open cooling tower?

2. Does the chiller trip out on low delta temperature or high head pressure?

3. Does the condenser water appear dirty?

If you answered "yes" to the first question and "yes" to either of the other questions, investigate this technology for your facility.

How Much Does It Cost and How Much Did It Save?

The total installed cost of the sand filter at NAS Lemoore was $26,553. The total annual savings varies based on the cleaning schedule of the existing chiller. The analysis of this system shows $11,466 average annual savings for an annual chiller cleaning schedule, $19,033 average annual savings for a two (2) year cleaning schedule, and $28,267 average annual savings for a three (3) year cleaning schedule. Annual savings increase with a greater length of time between cleanings for a system without a sand filter.

What Are the Maintenance Cost / Savings Issues?

Other than normal pump maintenance for the water circulation pump which is minimal, the only regular maintenance cost associated with the filter system is replacement of the sand medium. On average, the sand should be replaced every seven years but this could be shorter or longer depending on the frequency of regeneration and water quality. The NAS Lemoore filter holds 350 lbs. of sand which will cost approximately $500 to replace.

Maintenance savings theoretically comes from a reduction in the number of mechanical chiller cleanings required to keep the chiller operating efficiently. Due to chiller cleanings before both the baseline and performance testing periods, the chillers did not experience scheduled cleanings during the data collection periods. The long term effect on cleaning frequency could not be determined during the short period of this study.

What Are the Findings, Conclusions, and Recommendations?

Findings

The technology demonstration revealed that the overall savings were exceptional. Since the assumed three (3) year chiller cleaning schedule shows the greatest savings, those values are presented in Table 1-1. Values presented in Table 1-1 are based on the normalized savings for a typical meteorological year.

	Baseline	Performance	Savings
Electrical Consumption, kWh	2,950,169	2,086,133	864,036
Electricity Rate, $/kWh	$0.09275	$0.09275	
Water Consumed, kgal	995	1,062	-68
Water Rate, $/kgal	$5.00	$5.00	
Electrical Cost	$273,628	$193,489	$80,139
Water Cost	$4,974	$5,312	-$338
Chiller Cleaning Cost	$5,000	*	$5,000
Total Savings (3 years)			$84,801**
Total Annual Saving (avg.)			**$28,267**
Installation Cost		$26,533	-$26,533
Simple Payback (yrs)			**0.94**

User findings/comments

The energy manager at the site reported that the sand filter was on line from spring of 2007 until approximately 2013 when maintenance disconnected the filter for unknown reasons. It is speculated that either there was some sort of fault that maintenance was reluctant to fix or perhaps the sand was nearing its expected end of life of 7 years and so the filter was taken off line instead of replacing the sand. The replacement of this sand filter with a centrifugal separator is now a part of a UESC scheduled later this year.

The energy manager reports that other sand filters on the base that are serviced by maintenance contractors operate well with no issues.

The energy manager reports that the overall experience with the sand filter was positive. It filtered the water well, reduced the maintenance on the heat exchangers and had no maintenance issues.

For a full report on this project go to:

https://hub.navfac.navy.mil/webcenter/portal/exwc/Business_-_Program_Lines/page16/page160/page1455?_afrLoop=45662220730323&_adf.ctrl-state=2gppxgl9i_105#!

For additional information:

Paul Kistler, P.E, CEM, NAVFAC EXWC Code PW61, paul.kistler@navy.mil
Jim Heller, Energy Management and Engineering Division Director, Code PW61, james.heller@navy.mil